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A PILOT STUDY OF THE POTENTIAL FOR NAVY UTILIZATION OF SOLID WASTE DERIVED FUELS TO OFFSET FOSSIL FUEL CONSUMPTION

Final Report

June 1978

Submitted to:

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A brief study was made to define problems that would be encountered in estimating potential Navy markets for various forms of waste derived fuels. Fossil fuel consumption estimates for boiler plants at several Navy activities were converted to waste derived fuel (WDF) estimates using a set of assumed rules judged technically feasible regarding boiler conversions and confirming o Fossil Fuels and WDF. The results of this first study are presented indicating Navy boilers might represent a significant market for all the WDF. A region could produce if the WDF were available in- CONT

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liquid as well as solid forms. The economic feasibility of conversions and WDF production are not addressed in this brief paper.

SRI International

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SRI Project 4677
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TABLES

PREFACE

This report covers one of three separate but related tasks completed under Contract N00014-76-C-0351 for SRI's research planning and analytical support to the Navy solid waste RDT&E program for FY 1977. The tasks are: the characterization of Navy participation in regional solid waste systems, case studies of the R^4 Program for regionalized studies, and assessment of the potential for Navy use of solid waste devised fuels. Each of these tasks is directly related to a corresponding task outlined in the 1976 NAVFAC Development Plan.

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This research would not have been possible without the generous cooperation of Navy personnel within OP-45 CNO, the NAVFAC Environmental Protection Program Office, the Civil Engineering Laboratory-Environmental Support Office (NESO), and the NAVFAC Energy Program. We would particularly like to thank the following persons for their individual effort and support:

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A. Introduction

The future of resource recovery in the Navy will hinge on demonstrating (1) cost savings in solid waste management, (2) compliance with environmental guidelines, and (3) energy savings. Until these factors are defined under numerous Navy operational conditions, forecasts of how many and what kinds of resource recovery systems are likely to be used in the Navy by 1985 will be unreliable. Current forecasts are very much a matter of (1) subjective judgments and assumptions concerning these factors and (2) the ways in which the analyses are performed to arrive at estimates of benefits and costs.

Specifically, estimates of the overall benefits that could accrue to the Navy if it were to institute a comprehensive resource recovery program at its shore facilities will vary widely, depending on the methods used to estimate the quantity of wastes that will be processed, to predict the values of products that could be recovered, and to project a schedule of program implementation. Comparable difficulties are faced in estimating the costs of a Navy-wide resource recovery program. System analysts must deal with large process cost uncertainties and with site-dependent costs such as land, transportation, and labor.

Regardless of the difficulties in estimating the costs and benefits of resource recovery, it is important that a current, best possible estimate of the potential for resource recovery be maintained and available within the Navy. For instance, for use in middle- and long-term planning and programming, some measure is needed of the probable upper and lower bounds of the financial impacts resource recovery may have on equipment

procurement, personnel, and operations and maintenance budgets. Also, analytically based guidance concerning the potential of resource recovery is needed in setting solid waste management policy and priorities, particularly in solid waste R&D matters related to resource recovery, pollution abatement, and energy conservation programs.

This memorandum covers SRI exploration of a method of analysis that may facilitate forecasting the future of Navy-wide resource recovery by maximizing operational realism in the method of evaluation. The development of this method is based on the premise that the principal driving force behind the choices and implementation of resource recovery systems within the Navy will ultimately be the economics of fossil fuel consumption offsets (in either heat or substitute waste-derived fuels) employing existing energy systems with only minimum modifications.

A brief discussion is given in the next section of several alternative methods to assess the future of resource recovery in the Navy. Approaches currently being considered for use in evaluating costs and benefits of resource recovery strategies and options are compared with the one being developed and tested here. Although essentially the same data ingredients are needed regardless of method used, we believe the conclusions reached may be quite different, depending on the approach taken.

This is a pilot study in that it is a first limited effort to develop and test a method of analysis for possibly broader (Navy-wide/DoD-wide) application. The results given here are indicative only of the kinds of information obtained with the method under study, using readily available data on a small sample of arbitrarily chosen Navy facilities.

No general conclusions are drawn or should be drawn from these first examples concerning the potential of resource recovery in the Navy as a whole. Much more work is needed before a complete profile of the Navy's potential for utilizing waste-derived fuels is obtained. A technique for general Navy-wide application of the method is suggested in a concluding section of this memorandum.

B. Alternative Approaches to Evaluating Resource Recovery Potential

Several approaches have been suggested, and employed to varying degrees, for evaluating the potential of resource recovery within the Navy. They differ generally in ways directly related to assumptions as to which of the many conditions or parameters defining the Navy's resource recovery problem dominate the economics of the implementation options (e.g., parameters such as site, type of process, and scale of process). One approach is based on an underlying assumption that, regardless of other factors, solid waste processing economics (hence system cost-effectiveness) will improve with increased process scale. Since individual Navy activity waste streams are relatively small, this approach (which assumes that only those facilities with scales of waste generation above a set threshold, e.g., 100 tpd, can be cost-effective) obviously forces the evaluations toward Navy participation in regional systems, i.e., multiactivity or jointly utilized large-scale (500 tpd or more) systems.

Another approach that has been suggested underscores site-specific factors. This emphasis leads to conducting a large number of individual cost-effectiveness studies of separate facilities (perhaps 200 or more to cover the major Navy activities) before an integrated profile of the potential can be developed.

The first approach is promoted by analysts who believe that the Navy will join or implement predominantly large systems, that the Navy's solutions will follow in time and along the technical lines of those of municipalities.* However, other investigators point to unresolved problems currently being encountered in all attempts to implement large-scale municipal systems where more than one or two agencies are involved. Based on this experience, it could be argued that few, if any, Navy systems are likely to be regional or large scale. Does this mean that site-specific, tailored, small-scale systems, individually managed and operated, will

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*Navy activities have the option of joining municipal systems and are encouraged to do so at present. Whether arrangements can be worked out that are satisfactory and will remain so over time remains to be seen.

evolve at numerous Navy activities? Not necessarily. With the limited availability of proven processing systems at present, it is unlikely that a large number of Navy activities will have found cost-effective solutions by 1985.

Of the several approaches that have been proposed to assess the potential of Navy utilization of waste-derived fuels, one has received particular attention following recent promulgation of Resource Recovery Facility guidelines mandating implementation of resource recovery by federal activities in SMSAs under certain conditions. Presumably, some major institutional problems such as legal restrictions and political issues could be avoided if the system or systems served only federal activities in a region. If this alternative analytical approach is chosen, it is already known (based on estimates of the daily generation rates of the federal activities in regions) that the process scale would be bounded by only a few hundred tons per day of waste as an upper limit. With this approach, it is uncertain that site-specific requirements of the individual activities in the federal system could be satisfied with any single system. Based on the results of feasibility studies of this option performed by the Navy, it appears unlikely at this time that more than a few, if any, Navy activities will be served by regionalized federal systems in 1985. What does seem quite clear is that the profiles of Navy utilization of waste-derived fuels that are developed using approaches such as these would strongly reflect the initial assumptions of each approach and in effect bias the results toward those assumptions.

After reviewing the problems inherent with the above approaches, SRI concluded that a fresh approach to predicting the future of resource recovery in the Navy was needed. Returning to analytical fundamentals, we decided to attempt to develop a procedure that would emphasize the energy or fuel (type and quantity) demand as the basic independent variable. Navy activity fuel demands would be charted to show geographically the markets that the waste processor (Navy or otherwise) would serve. We assume that, when it is technically and economically feasible to produce heat or a fuel from the waste generated in the area at a price that the market will pay, resource recovery will become a fact.

This approach will not answer immediately questions of regionalization, scale, or site-specific requirements. But it does place emphasis on market and process factors, leaving regionalization, scale, and other considerations to be decided later.

The first step in developing this approach is to examine in detail Navy boiler fuel requirements by geographic areas. These fuel requirements may be summed for each Navy activity by quarters over the yearly cycle. Estimates of the waste generated and heat value that could be recovered by the activities in an area are then made. The fuel demands and waste heat resource are then compared and types and quantities of waste-derived fuels are identified that could be processed and consumed most readily by the activity or activities in the area.

The next step anticipated would be to examine potential waste refinery or heat recovery sites in each area to minimize logistic problems.

The final step would be to examine process economics and site factors (land, labor, etc.) to determine if a refinery operating under those conditions and producing fuels or heat for those markets would be economically viable. Questions of regions and scale would be introduced in this final step after heat or fuel demands and waste fuel supply potential have been matched.

It is readily seen that this approach is different from others, primarily in the order in which the steps are taken. The fuel/waste matching approach SRI is investigating does not assume a priori any size or any orientation toward a given fuel form or process. In other words, it avoids as much as possible the connotation of a "technical solution looking for an operational problem."

C. Testing Step One--Example Data on Selected Navy Activity Boiler Fuel Demands/RDF Use Potential

Fuels consumed by Navy activities are reported in several different forms and levels of detail.* For the purpose of this pilot study, the

*See (1) "Utilities Procurement Report" NAVFAC 11300-1, (2) Defense Energy Info System--DEIS II Reports, (3) NAPSIS: Master File Report--FACSO 9593/F5595ROI, and (4) Navy "Boiler Tune Up" (BTU) Program.

data used are for the most part those given in the NAPSIS Master File Report. This report provides quarterly estimates of the fuel consumed by each boiler (more than 1900) at more than 200 Navy shore activities. Boiler size and type are also given in this master file, along with geographic location (latitude and longitude) of the boiler installation. More detailed information than is given in this master file on the age and type of each boiler would be needed in engineering feasibility or design studies,* but for the purpose of this pilot study these NAPSIS data are considered sufficient.

The study activities initially selected for analysis in this pilot study were those in the Norfolk area (Table 1). The choice of this area had no special significance other than that the area was known to contain a number of different kinds of Navy activities and was thought likely to provide a representative view of types of Navy boilers and fuels consumed. Subsequently, boiler/fuel data were compiled for activities in areas immediately surrounding NAS Pensacola (Table 2), NAS Hawthorne (Table 3), NTC Greatlakes (Table 4), NAS Menphis (Table 5), and NAS Jacksonville (Table 6).

Some conclusions might be drawn regarding resource recovery processes, heat recovery systems, and/or kinds of fuels that would most likely find stable markets in each of the areas examined in Tables 1 through 6. Preliminary observations are indicated on each table, e.g., dollar/fuel saving potential; but we believe such conclusions would be premature since several more analytical steps as described above in Section B are needed to complete the profile of each area. Certainly, much more work is needed--examining more areas and projecting possible changes in heat or fuel needs over the next 10 years--before any conclusions should be drawn concerning the Navy as a whole.

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*Detailed descriptions of boilers and fuel consumption are submitted in completed R^4 reports. More than 30 R^4 reports are available through NESO and may be useful in any follow-on effort.

One conclusion, however, is that, although the methodology is tedious, the view gained during the studies of the areas as waste fuel markets and of their historical records of fuel consumption gives the analyst a strong operational orientation. The plants studied are in being and represent the status quo. Whatever changes or assumptions the analyst wishes to study, each must deal realistically with facts such as training, personnel ceilings, and general inertia to change. This, we believe, is a proper orientation to reliable forecasting of operational responses of the Navy.

Page	Activity	Location	Size (MMBtu/hr)	Operating Time Hours/ Day	Days/ Week	Weeks/ Year	Fuel	Throughput (kgal or tons) Annual	Max. Hourly	Lo (perc Dec	Mar
1825	Air Station	LP 167	10.0	24	7	30	Res. oil	35	67	60	20
1826	Comm. Area Master Sta.	D-2	8.0	24	7	52	Res. oil	100	50	38	26
1827	Comm. Area Master Sta.	D-2	8.0	24	7	52	Res. oil	100	50	38	26
1828	Amphib. Base	757-109 Wickes	90.0	24	7	52	Res. oil	2433	608	35	25
1829	Amphib. Base	757-108	90.0	24	7	52	Res. oil	2433	608	35	25
1830	Amphib. Base	757-107	90.0	24	7	52	Res. oil	2433	608	35	25
1831	PWC Norfolk	P-1 59	100.0	24	7	48	Res. oil	4500	833	35	26
1832	PWC Norfolk	P-1 60	100.0	24	7	48	Res. oil	4500	833	35	26
1833	PWC Norfolk	P-1 61	100.0	24	7	48	Res. oil	4500	833	35	26
1834	PWC Norfolk	P-1 62	115.0	24	7	48	Res. oil	5100	833	35	26
1835	PWC Norfolk	P-1 44	40.0	24	7	48	Res. oil	1500	340	35	26
1836	PWC Norfolk	P-1 55	75.0	24	7	48	Res. oil	3300	545	35	26
1837	PWC Norfolk	P-1 56	75.0	24	7	48	Res. oil	3300	545	35	26
1838	PWC Norfolk	P-1 57	75.0	24	7	48	Res. oil	3300	545	35	26
1839	PWC Norfolk	SP-85 79	75.0	24	7	26	Dist. oil	441	510	91	0
1840	PWC Norfolk	SP-85 80	75.0	24	7	26	Dist. oil	441	510	91	0
1841	PWC Norfolk	NH-200 81	75.0	24	7	17	Res. oil	637	545	77	18
1842	PWC Norfolk	NH-200 83	75.0	24	7	17	Res. oil	637	545	77	18
1843	PWC Norfolk	Z-309 219	54.0	24	5	26	Res. oil	270	510	20	32
1844	PWC Norfolk	Z-309 220	54.0	24	5	26	Res. oil	270	510	20	32
1845	PWC Norfolk	Z-309 220	54.0	24	5	52	Refuse	18000 tons	7.5 T	25	25
1846	PWC Norfolk	Z-309 219	54.0	24	5	52	Refuse	18000 tons		25	25
1847	Supply Center	C-125 72	20.0	24	7	52	Res. oil	352	143	35	25
1848	Supply Center	C-125 90	8.0	24	7	52	Res. oil	141	57	35	25
1849	Supply Center	C-125 91	8.0	24	7	52	Res. oil	141	57	35	25
1850	Security Group	NW 2-1 Nat. Steel	5.0	24	7	52	Res. oil	80	17	60	10
1851	Security Group	NW 2-2	5.0	24	7	16	Res. oil	80	17	60	10
1852	Security Group	NW-2 9	10.0	24	7	44	Dist. oil	150	23	40	25

Table 1

NORFOLK AREA NAVY BOILERS/RDF USE POTENTIAL

roughput (l or tons)		Load (percent)					Plant Energy Use (MMBtu)				
al	Max. Hourly	Dec	Mar	Jun	Sep	Year Constructed	Total Annual	Dec	Mar	Jun	Sep
	67	60	20	0	20		4.9×10^3	2.9×10^3	1.0×10^3	0	1.0×10^3
	50	38	26	12	24		28×10^3	10.6×10^3	7.3×10^3	3.3×10^3	6.6×10^3
	50	38	26	12	24						
	608	35	25	15	25						
	608	35	25	15	25		1021×10^3	358×10^3	255×10^3	153×10^3	255×10^3
	608	35	25	15	25						
	833	35	26	16	23						
	833	35	26	16	23						
	833	35	26	16	23						
	833	35	26	16	23		4200×10^3	1470×10^3	1092×10^3	672×10^3	966×10^3
	340	35	26	16	23						
	545	35	26	16	23						
	545	35	26	16	23						
	545	35	26	16	23						
	510	91	0	0	9		123×10^3	112×10^3	0	0	11×10^3
	510	91	0	0	9						
	545	77	18	2	3		178×10^3	137×10^3	32×10^3	3.5×10^3	5.4×10^3
	545	77	18	2	3						
	510	20	32	6	42		75.6×10^3	15×10^3	24×10^3	5×10^3	31×10^3
	510	20	32	6	42						
ons	7.5 T	25	25	25	25		360×10^3	90×10^3	90×10^3	90×10^3	90×10^3
ons		25	25	25	25						
	143	35	25	15	25						
	57	35	25	15	25		88.7×10^3	31×10^3	22×10^3	13×10^3	31×10^3
	57	35	25	15	25						
	17	60	10	10	20		22.4×10^3	13.4×10^3	2.2×10^3	2.2×10^3	4.4×10^3
	17	60	10	10	20						
	23	40	25	10	25		21×10^3	8.4×10^3	5.2×10^3	2.1×10^3	5.2×10^3

Page	Activity	Location	Size (MMBtu/hr)	Operating Time Hours/ Day	Days/ Week	Weeks/ Year	Fuel	Throughput (kgal or tons) Annual	Max. Hourly	Load (percen Dec	Mar
1853	Shipyard/Ports.	174-11 Riley Stoker	150	24	7	52	Res. oil	3900	800	35	25
1854	Shipyard/Ports.	174-13 Riley Stoker	150	24	7	52	Res. oil	3900	810	35	25
1855	Shipyard/Ports.	174-14 Riley Stoker	150	24	7	52	Res. oil	3900	810	35	25
1856	Shipyard/Ports.	174 9 Combustion	150	24	7	52	Res. oil	3900	810	35	25
1857	Shipyard/Ports.	174 10 Combustion	150	24	7	52	Res. oil	3900	810	35	25
1858	Shipyard/Ports.	174 11 Combustion	150	24	7	52	Res. oil	3900	810	35	25
1859	Shipyard/Ports.	871 S-2 Continental	7.0	24	7	52	Res. oil	49	48	36	31
1860	Shipyard/Ports.	481 24 Continental	7.0	24	7	30	Res. oil	49	48	59	35
1861	Shipyard/Ports.	481 25 Continental	7.0	24	7	30	Res. oil	49	48	59	35
1862	Shipyard/Ports.	481 26 Continental	7.0	24	7	30	Res. oil	49	48	59	35
1863	Shipyard/Ports.	871 S-3 Superior	7.0	24	7	52	Res. oil	49	48	36	31
1864	Shipyard/Ports.	871 S-1 Continental	7.0	24	7	52	Res. oil	49	48	36	31
1865	Regional Med. Ctr.	20-107	36.0	24	7	52	Res. oil	300		45	30
1866	Regional Med. Ctr.	20 106	36.0	24	7	52	Res. oil	300		45	30
1867	Regional Med. Ctr.	20 105	36.0	24	7	52	Res. oil	300		45	30
1868	Regional Med. Ctr.	20 62	24.0	24	7	52	Res. oil	300		45	30
1893	Air Sta. Oceana	601 210 Union Iron	70.0	24	7	52	Res. oil	930	466	35	25
1894	Air Sta. Oceana	601 210 Union Iron	70.0	24	7	52	Res. oil	930	466	35	25
1895	Air Sta. Oceana	601 212 Bigelow	70.0	24	7	52	Res. oil	930	466	35	25
1896	Air Sta. Oceana	601 235 Eire City	35.0	24	7	52	Res. oil	420	235	35	25
1897	Air Sta. Oceana	4000 Cleaver Brooks	12.0	24	7	52	Res. oil	121	107	35	25
1898	Air Sta. Oceana	4000 625	12.0	24	7	52	Res. oil	121	107	35	25
1899	Air Sta. Oceana	4000 655	12.0	24	7	52	Res. oil	121	107	35	25

Table 1 (Continued)

Throughput (kgal or tons)		Load (percent)				Year Constructed	Plant Energy Use (MMBtu)				
Annual	Max. Hourly	Dec	Mar	Jun	Sep		Total Annual	Dec	Mar	Jun	Sep
3900	800	35	25	15	25		3275×10^3	1146×10^3	819×10^3	491×10^3	819×10^3
3900	810	35	25	15	25						
3900	810	35	25	15	25						
3900	810	35	25	15	25						
3900	810	35	25	15	25						
3900	810	35	25	15	25						
49	48	36	31	7	26		6.9×10^3	2.5×10^3	2.1×10^3	0.5×10^3	1.8×10^3
49	48	59	35	0	6		34.3×10^3	20.2×10^3	12×10^3	0	2.0×10^3
49	48	59	35	0	6						
49	48	59	35	0	6						
49	48	36	31	7	26		13.7×10^3	5×10^3	4.3×10^3	1×10^3	3.6×10^3
49	48	36	31	7	26						
300		45	30	7	18		168×10^3	76.5×10^3	50×10^3	11.8×10^3	30×10^3
300		45	30	7	18						
300		45	30	7	18						
300		45	30	7	18						
930	466	35	25	15	25		449×10^3	157×10^3	112×10^3	67×10^3	112×10^3
930	466	35	25	15	25						
930	466	35	25	15	25						
420	235	35	25	15	25						
121	107	35	25	15	25		50.8×10^3	17×10^3	12.7×10^3	7.6×10^3	12.7×10^3
121	107	35	25	15	25						
121	107	35	25	15	25						

Page	Activity	Location	Size (MMBtu/hr)	Operating Time Hours/ Day	Days/ Week	Weeks/ Year	Fuel	Throughput (kgal or tons) Annual	Max. Hourly	Dec	L (per Mar
1900	CDSTCA Dam Neck	529 192 Wickes	20.0	24	7	52	Res. oil	372	133	40	25
1901	DCSTCA Dam Neck	529 193 Wickes	22.0	24	7	52	Res. oil	409	147	40	25
1902	DCSTCA Dam Neck	529 194 Wickes	22.0	24	7	52	Res. oil	409	147	40	25
1903	CDSTCA Dam Neck	529 195 Wickes	22.0	24	7	52	Res. oil	409	147	40	25
1904	CDSTCA Dam Neck	241 Spencer	6.0	24	7	52	Res. oil	116	41	40	25
1905	W.S. St. Juliens	283 1 B & W	34.0	24	7	52	Res. oil	885	234	25	10
1906	W.S. St. Juliens	283 2 B & W	34.0	24	7	52	Res. oil	885	234	25	10
1907	W.S. St. Juliens	319	10.0	24	7	52	Res. oil	18	69	25	10
1908	W.S. Yorktown	5-2	7.0	Not in use							
1909	W.S. Yorktown	5-3	7.0	Not in use							
1910	W.S. Yorktown	3	6.0				Res. oil	204		35	25
1911	W.S. Yorktown	370-106	6.0	24	7	40	Res. oil	100	40	70	10
1912	W.S. Yorktown	306-66	8.0	24	7	40	Res. oil	192	53	70	10
1913	W.S. Yorktown	93-60	6.0	24	7	40	Res. oil	98	40	70	10
1914	W.S. Yorktown	708-110	6.0	24	7	40	Res. oil	212	40	35	25
1915	W.S. Yorktown	708-111	6.0	24	7	40	Res. oil	212	40	35	25
1916	W.S. Yorktown	708-112	6.0	24	7	40	Res. oil	212	40	35	25
1917	W.S. Yorktown	476 105	8.0	24	7	40	Res. oil	100	53	35	25
1918	W.S. Yorktown	476 22	5.0	24	7	40	Res. oil	47	33	35	25
1919	W.S. Yorktown	1388 90	6.0	24	7	40	Res. oil	138	40	35	25
1920	W.S. Yorktown	1388 91	6.0	24	7	40	Res. oil	138	40	35	25
1921	W.S. Yorktown	457-87	6.0	24	7	40	Dist. oil	660	42	35	25
1922	W.S. Yorktown	457-88	6.0	24	7	40	Dist. oil	660	42	35	2
1923	W.S. Yorktown	457-89	6.0	24	7	40	Dist. oil	660	42	35	2
1924	W.S. Yorktown	B-86	6.0	24	7	40	Dist. oil	45	42	70	1
1925	W.S. Yorktown	3-84	6.0	24	7	40	Res. oil	204	40	35	2
1926	W.S. Yorktown	3-85	6.0	24	7	40	Res. oil	204	40	35	2
1927	W.S. Yorktown	13 76	9.0	24	7	40	Res. oil	223	60	35	2
1928	W.S. Yorktown	13 77	9.0	24	7	40	Res. oil	223	60	35	2
1929	W.S. Yorktown	13 78	9.0	24	7	40	Res. oil	223	60	35	2

Table 1 (Continued)

...ughput (...or tons) Max. Hourly	Load (percent) Dec	Mar	Jun	Sep	Year Constructed	Plant Energy Use (MMBtu) Total Annual	Dec	Mar	Jun	Sep
133	40	25	10	25						
147	40	25	10	25						
147	40	25	10	25		224×10^3	90×10^3	56×10^3	22×10^3	56×10^3
147	40	25	15	25						
41	40	25	15	25		16×10^3	6.5×10^3	4×10^3	2.4×10^3	4×10^3
234	25	10	25	40						
234	25	10	25	40		250×10^3	62×10^3	25×10^3	62×10^3	100×10^3
69	25	10	25	40		2.5×10^3	0.6×10^3	0.2×10^3	0.6×10^3	1.0×10^3
	35	25	15	25		29×10^3	10×10^3	7×10^3	5×10^3	7×10^3
40	70	10	0	20		14×10^3	9.8×10^3	1.4×10^3	0	2.8×10^3
53	70	10	0	20		26×10^3	18.8×10^3	2.6×10^3	0	5.2×10^3
40	70	10	0	20		14×10^3	9.8×10^3	1.4×10^3	0	2.8×10^3
40	35	25	15	25						
40	35	25	15	25		89×10^3	31×10^3	22×10^3	13×10^3	22×10^3
40	35	25	15	25						
53	35	25	15	25		21×10^3	7.2×10^3	5.3×10^3	3.2×10^3	5.3×10^3
33	35	25	15	25						
40	35	25	15	25		39×10^3	13×10^3	9.8×10^3	5.8×10^3	9.8×10^3
40	35	25	15	25						
42	35	25	15	25						
42	35	25	15	25		277×10^3	97×10^3	70×10^3	40×10^3	70×10^3
42	35	25	15	25						
42	70	10	0	20		6.3×10^3	4.4×10^3	0.6×10^3	0	1.2×10^3
40	35	25	15	25		57×10^3	20×10^3	15×10^3	7×10^3	15×10^3
40	35	25	15	25						
60	35	25	15	25						
60	35	25	15	25		94×10^3	33×10^3	24×10^3	14×10^3	24×10^3
60	35	25	15	25						

2

Page	Activity	Location	Size (MMBtu/hr)	Operating Time: Hours/ Day	Operating Time: Days/ Week	Operating Time: Weeks/ Year	Fuel	Throughput (kgal or tons): Annual	Throughput (kgal or tons): Max. Hourly	Load (percen…: Dec	Load (percen…: Mar	Load (percen…: Ju…
1930	W.S. Yorktown	431-71	5.0	24	7	40	Res. oil	32.0	33	70	10	[illegible]
1931	W.S. Yorktown	12 61	12.0	24	7	40	Res. oil	68.0	80	70	10	[illegible]
1932	W.S. Yorktown	12 79	10.0	24	7	40	Res. oil	68.0	66	70	10	[illegible]
1933	W.S. Yorktown	118 113	9.0	24	7	40	Res. oil	100	60	35	25	1[illegible]
1934	W.S. Yorktown	118 114	9.0	24	7	40	Res. oil	100	60	35	25	1[illegible]
1935	W.S. Yorktown	118 68	6.0	24	7	40	Res. oil	200	40	35	25	1[illegible]
1936	W.S. Yorktown	118 69	6.0	24	7	40	Res. oil	200	40	35	25	1[illegible]
											Totals	

Notes: 1. Solid waste generated (tpd_5)*

Norfolk Naval Station Portsmouth NSY	140
Amphib. Base	45
Medical Center	3
Oceana NAS	35
Dam Neck T.C.	14
St. Juliens W.S.	
Yorktown W.S.	35
	272†

2. Unrecovered heat from remaining area waste is 34,720 tpy ≅ 347 x 10^3 MMBtu (~ \$700,000/yr at \$2.00/MMBtu) or about

$$\frac{347}{11,384} = 3\% \text{ of total heat load.}$$

3. Total energy use can be converted to barrels of oil per year as follows:

1 bbl = 42 gal x 140,000 Btu/gal = 5.8 x 10^6 Btu

$$\frac{11,384 \times 10^9}{5.8 \times 10^6} = 1,963,000 \text{ bbl or oil/yr.}$$

89 boilers identified (NAPSIS), oil fired.

24 multiboiler plants all using fuel oils at present.

1 refuse-fired steam plant.

*CBC ltr 12 Nov 1976, Ser 5014 to OP 45. (Kneeling's ltr signed by CDR John Lucas, USN.)

†Or 70,720 tpy (of which 36,000 tpy are already processed at refuse heat recovery plant).

Table 1 (Concluded)

s) Max. Hourly	Load (percent) Dec	Mar	Jun	Sep	Year Constructed	Plant Energy Use (MMBtu) Total Annual	Dec	Mar	Jun	Sep
3	70	10	0	20		4.4×10^3	3.1×10^3	0.4×10^3	0	0.8×10^3
0	70	10	0	20		19×10^3	13×10^3	1.9×10^3	0	3.8×10^3
6	70	10	0	20						
0	35	25	15	25						
0	35	25	15	25		84×10^3	29×10^3	21×10^3	13×10^3	21×10^3
0	35	25	15	25						
0	35	25	15	25						
	Totals (10^3 MMBtu)					11,384	4,126	2,809	2,711	2,739

2.00/MMBtu)

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Page	Activity	Location	Size (MMBtu/hr)	Operating Time Hours/ Day	Days/ Week	Weeks/ Year	Fuel	Throughput (MMcf/kgal) Annual	Max. Hourly	Load (percent) Dec	Mar	Jun
848	Air Station	3289-135	4.0	24	7	22	N.G.	3.0	0.004	57	13	0
849	Air Station	136	4.0	24	7	22	N.G.	3.0	0.004	57	13	0
850	Air Station	463-1 Eclipse	1.0	24	7	52	N.G.	7.5	0.001	25	25	25
851	Air Station	600-1 Kewanee	4.0	24	7	12	N.G.	7.0	0.004	50	30	0
852	Air Station	653-53 Farrar & Trefts	2.0	24	7	12	N.G.	3.0	0.002	50	30	0
853	Air Station	660-60 Farrar & Trefts	2.0	24	7	12	N.G.	3.0	0.002	50	30	0
854	Air Station	671-1 Peerless	4.0	24	7	52	N.G.	25.0	0.004	25	25	25
855	Air Station	672-1 Am. Stand.	4.0	24	7	52	N.G.	28.0	0.004	25	25	25
856	Air Station	1500-1 Am. Rad.	2.0	24	7	52	N.G.	17.0	0.002	25	25	25
857	Air Station	1500-2 Am. Rad.	2.0	24	7	12	N.G.	3.0	0.002	50	30	0
858	Air Station	2268-1 Kewanee	22.0				N.G.					
859	Air Station	2268-2 Kewanee	22.0				N.G.					
860	Air Station	2268-3 Kewanee	22.0				N.G.					
861	Air Station	615 Fitzgibbons	6.0	24	7	52	N.G.	50.0	0.006	25	25	25
862	PWC	782-1	125.0	24	7	40	N.G./Dist.	673/14.0	0.125/0.893	23	22	26
863	PWC	782-2	125.0	24	7	40	N.G./Dist.	673/14.0	0.125/0.893	23	22	26
864	PWC	782-3	200.0	24	7	24	N.G.	425.0	0.200	23	22	26
865	PWC	504-103	18.0	24	7	26	N.G.	32.0	0.018	25	24	26
866	PWC	504-104	18.0	24	7	26	N.G.	32.0	0.018	25	24	26
867	PWC	504-129	15.0	24	7	26	N.G.	32.0	0.015	25	24	26
868	PWC	504-130	15.0	24	7	26	N.G.	32.0	0.015	25	24	26
869	PWC	913-68	15.0	24	7	9	N.G.	15.0	0.015	27	31	25
870	PWC	913-71	15.0	24	7	9	N.G.	15.0	0.015	27	31	25
871	PWC	913-119	5.0	24	7	26	N.G.	23.0	0.005	27	31	25
872	PWC	913-67	17.0	24	7	9	N.G.	15.0	0.017	27	31	25

Table 2

PENSACOLA NAVY BOILERS/RDF
USE POTENTIAL

	Load (percent)					Plant Energy Use (MMBtu)				
ourly	Dec	Mar	Jun	Sep	Year Constructed	Total Annual	Dec	Mar	Jun	Sep
	57	13	0	30		6180	3523	803	0	1854
	57	13	0	30						
	25	25	25	25		7725	1931	1931	1931	1931
	50	30	0	20		7210	3605	2163	0	1442
	50	30	0	20		6180	3090	1854	0	1236
	50	30	0	20						
	25	25	25	25		54590	13648	13648	13648	13648
	25	25	25	25						
	25	25	25	25		17510	4378	4378	4378	4378
	50	30	0	20		3090	1545	927	0	618
					1975					
					1975					
					1975					
	25	25	25	25		50150	12537	12537	12537	12537
/0.893	23	22	26	29		Gas 1.8×10^6	0.42×10^6	0.40×10^6	0.47×10^6	0.56×10^6
/0.893	23	22	26	29						
	23	22	26	29		Oil 3920	901	862	1019	1137
	25	24	26	25		131840	32960	31642	34278	32960
	25	24	26	25						
	25	24	26	25						
	25	24	26	25						
	27	31	25	17		70040	18910	21712	17510	11906
	27	31	25	17						
	27	31	25	17						
	27	31	25	17						

Page	Activity	Location	Size (MMBtu/hr)	Operating Time Hours/ Day	Days/ Week	Weeks/ Year	Fuel	Throughput (MMcf/kgal) Annual	Max. Hourly	Load (percent) Dec	Mar	Jun
873	PWC	681-1 Rite	1.0	24	7	12	N.G.	2.0	0.001	50	30	0
874	PWC	458-73	12.0	24	7	26	N.G.	50.0	0.012	24	31	26
875	PWC	458-73	12.0	24	7	26	N.G.	50.0	0.012	24	31	26
876	PWC	458-75	12.0	24	7	26	N.G.	50.0	0.012	24	31	26
877	PWC	458-91	15.0	24	7	26	N.G.	50.0	0.015	24	31	26
878	PWC	1857-123	8.0	24	7	39	N.G./Dist.	24/1.0	0.008/0.057	25	28	23
879	PWC	1857-124	8.0	24	7	39	N.G./Dist.	24/1.0	0.008/0.057	25	28	23
880	PWC	1857-125	8.0	24	7	39	N.G./Dist.	24/1.0	0.008/0.057	25	28	23
881	Saufley Field	804-48	12.0	24	7	26	N.G.	30.0	0.012	24	23	26
882	Saufley Field	804-49	12.0	24	7	26	N.G.	30.0	0.012	24	23	26
883	Saufley Field	804-72	12.0	24	7	26	N.G.	30.0	0.012	24	23	26
884	Saufley Field	804-102	12.0	24	7	26	N.G.	30.0	0.012	24	23	26
885	NARF	3241-131 Am. Stand.	3.0	24	7	24	Dist.	15.0	0.022	50	30	0
886	NARF	3241-132 Am. Stand.	3.0	24	7	24	Dist.	15.0	0.022	50	30	0
887	NARF	3241-133 York Shipley	3.0	24	7	24	Dist.	15.0	0.021	50	30	0
888	NARF	3241-134	3.0	24	7	24	Dist.	15.0	0.021	50	30	0

Total (gas

Total (oil

Overall (M

Notes: 1. Navy solid waste (estimated per feasibility study--SOUTHDIV 10/77)

$53\ tpd_5 = 13{,}818\ tpy = 27.6 \times 10^6\ lb/yr$

Energy estimate 4500 Btu/lb raw refuse

$\therefore$ Energy in waste $= 27.6 \times 4.5 \times 10^3$ MMBtu/yr

$= 124.2 \times 10^3 = 0.124 \times 10^6$ MMBtu/yr

Value at \$2.00/MMBtu = \$248,000

2.a. Maximum solid waste ene
of total energy load.

b. If waste were converted
approximately 28 times

c. However, if used in PWC
required by these boile

Table 2 (Concluded)

	Load (percent)					Plant Energy Use (MMBtu)				
rly	Dec	Mar	Jun	Sep	Year Constructed	Total Annual	Dec	Mar	Jun	Sep
	50	30	0	20						
	24	31	26	19						
	24	31	26	19		0.2×10^6	49×10^3	64×10^3	53×10^3	39×10^3
	24	31	26	19						
	24	31	26	19						
.057	25	28	23	24		Gas				
.057	25	28	23	24		74×10^3	19×10^3	21×10^3	17×10^3	18×10^3
.057	25	28	23	24		Oil 420	105	118	97	100
	24	23	26	27						
	24	23	26	27		124×10^3	29×10^3	28×10^3	32×10^3	33×10^3
	24	23	26	27						
	24	23	26	27						
	50	30	0	20						
	50	30	0	20		62×10^3	31×10^3	19×10^3	0	12×10^3
	50	30	0	20						
	50	30	0	20						
	Total (gas)					2.6×10^6	643×10^3	624×10^3	657×10^3	744×10^3
	Total (oil)					4.3×10^3	1×10^3	1×10^3	1.1×10^3	1.2×10^3
	Overall (MMBtu)					2.6×10^6	0.644×10^6	0.625×10^6	0.658×10^6	0.745×10^6

aximum solid waste energy from Navy waste could provide 4.8% f total energy load. $\frac{0.124}{2.6} = 4.8\%$

f waste were converted to pyroil, the pyroil would be pproximately 28 times the present annual consumption. $\frac{124}{4.3} = 28$

owever, if used in PWC plant 782 boilers 1 and 2, pyroil could provide 9% of the energy equired by these boilers.

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Page	Activity	Location	Size (MMBtu/hr)	Operating Time Hours/ Day	Days/ Week	Weeks/ Year	Fuel	Throughput (kgal) Annual	Max. Hourly	Load (percent) Dec	Mar	Jun	Sep	Year Constructed
1239	NAD Hawthorne	13-1 Nebraska	18.0	24	7	52	Dist.	250	18	35	35	21	9	
1240	NAD Hawthorne	13-2	18.0	24	7	52	Dist.	250	18	35	35	21	9	
1241	NAD Hawthorne	13-3	18.0	24	7	52	Dist.	250	18	35	35	21	9	
1242	NAD Hawthorne	13-42 Munds	6.0	24	7	52	Dist.	44	6	35	35	21	9	
1243	NAD Hawthorne	103-6-24 Nebraska	18.0	24	7	52	Dist.	298	18	41	38	19	2	
1244	NAD Hawthorne	103-6-25	18.0	24	7	52	Dist.	298	18	41	38	19	2	
1245	NAD Hawthorne	103-6-26	18.0	24	7	52	Dist.	298	18	41	38	19	2	
1246	NAD Hawthorne	101-25-35 Pawnee	17.0	24	7	52	Dist.	114	17	22	42	15	21	
1247	NAD Hawthorne	49-31-37 Cyclotherm	6.0	24	5	30	Dist.	58	6	34	60	2	4	
1248	NAD Hawthorne	49-31-41 Munds	6.0	24	5	30	Dist.	58	6	34	60	2	4	
1249	NAD Hawthorne	101-42-39 Munds	6.0	24	5	30	Dist.	34	6	11	45	31	13	
1250	NAD Hawthorne	101-42-40	6.0	24	5	30	Dist.	39	6	11	45	31	13	
1251	NAD Hawthorne	101-25-34 Nebraska	18.0	24	7	52	Dist.	114	18	22	42	15	21	
1252	NAD Hawthorne	101-25-33	18.0	24	7	52	Dist.	298	18	22	42	15	21	
												Subtotal		
1232	NAS Fallon	314-1 Comb Eng	15.0	24	7	26	Dist.	350		33	35	20	12	
1233	NAS Fallon	314-2	15.0	24	7	26	Dist.	350		33	35	20	12	
1234	NAS Fallon	19-3 Farrar & Trefts	8.0	8	1	3	Dist.	1		0	99	1	0	
1235	NAS Fallon	19-5	6.0	8	2	6	Dist.	2		50	50	0	0	
1236	NAS Fallon	333-9 Orr & Emblower	8.0	8	7	39	Dist.	33		35	47	18	0	
1237	NAS Fallon	300-11 Munds	8.0	24	7	12	Dist.	48		37	53	10	0	
1238	NAS Fallon	19-4A	8.0	24	7	39	Dist.	175		34	51	15	0	
												Subtotal		
												Overall total		

*Included in plant total for pages 1251 and 1252.

†Oil equivalent: 53,000 bbl/yr (145 bbl/day average), or $660,000/yr at $2.00/MMBtu.

‡Oil equivalent: 21,000 bbl/yr

§Oil equivalent: 74,000 bbl/yr

Table 3

HAWTHORNE/FALLON NAVY BOILERS/RDF USE POTENTIAL

Load (percent)					Plant Energy Use (MMBtu)				
c	Mar	Jun	Sep	Year Constructed	Total Annual	Dec	Mar	Jun	Sep
5	35	21	9						
5	35	21	9		105×10^3	36.8×10^3	36.8×10^3	22.0×10^3	9.45×10^3
5	35	21	9						
5	35	21	9						
1	38	19	2						
1	38	19	2		125×10^3	51.3×10^3	47.5×10^3	23.8×10^3	2.50×10^3
1	38	19	2						
2	42	15	21		*				
4	60	2	4						
4	60	2	4		16.2×10^3	5.5×10^3	9.7×10^3	0.3×10^3	0.6×10^3
1	45	31	13						
1	45	31	13		10.2×10^3	1.1×10^3	4.6×10^3	3.2×10^3	1.3×10^3
2	42	15	21						
2	42	15	21		73.6×10^3	16.2×10^3	30.9×10^3	11.0×10^3	15.5×10^3
	Subtotal				$330 \times 10^{3\dagger}$	110.9×10^3	129.5×10^3	60.3×10^3	29.4×10^3
3	35	20	12						
3	35	20	12		9.8×10^3	32.3×10^3	34.3×10^3	19.6×10^3	11.7×10^3
0	99	1	0		0.14×10^3	0	0.14×10^3	--	0
0	50	0	0		0.28×10^3	0.14×10^3	0.14×10^3	0	0
5	47	18	0		4.6×10^3	1.6×10^3	2.2×10^3	0.83×10^3	0
7	53	10	0		6.7×10^3	2.5×10^3	3.6×10^3	0.67×10^3	0
4	51	15	0		24.5×10^3	8.3×10^3	12.5×10^3	3.6×10^3	0
	Subtotal				$134 \times 10^{3\ddagger}$	44.8×10^3	52.9×10^3	24.7×10^3	11.7×10^3
	Overall total				$464 \times 10^{3\S}$				

Oil equivalent: 21,000 bbl/yr.

Oil equivalent: 74,000 bbl/yr.

2

Page	Activity	Location	Size (MMBtu/hr)	Operating Time: Hours/ Days	Days/ Week	Weeks/ Year	Fuel	Throughput (MMcf/kgal): Annual	Max. Hourly	Load (percent): Dec	Mar	Jun	Sep
984	PWC	11-1	48.0	1	7	52	N.G./Res. Oil	5.0/8.0		37	26	14	23
985	PWC	11-2	48.0	1	7	52	N.G./Res. Oil	5.0/8.0		37	26	14	23
986	PWC	11-3	48.0	1	7	52	N.G./Res. Oil	5.0/8.0		37	26	14	23
987	PWC	11-4	96.0	1	7	52	N.G./Res. Oil	5.0/8.0		37	26	14	23
988	PWC	11-5	274.0	1	7	52	N.G.	1270		37	26	14	23
989	PWC	11-6	274.0	24	7	52	N.G.	1270		37	26	14	23
990	PWC	3511-1	21.0	24	7	39	N.G./Res. Oil	--/375		51	33	0	16
991	PWC	3511-2	21.0	24	7	39	N.G./Res. Oil	--/375		37	26	14	23
992	PWC	3400-1	9.0	24	7	52	N.G./Res. Oil	17/44		14	11	45	30
993	PWC	3400-2	9.0	24	7	52	N.G./Res. Oil	17/44		14	11	45	30
994	PWC	2711	6.0	24	7	39	N.G./Res. Oil	7/--		46	32	0	22
995	PWC	3211	5.0	24	7	52	N.G./Res. Oil	12/--		38	27	14	21
996	PWC	3211	5.0	24	7	52	N.G./Res. Oil	--		38	27	14	21
							Total	2613/870†				Total ga	
												Total oil	
												Overall	

Notes: 1. Solid waste = 40 tpd$_5$ or 10,400 tpy = $10 \times 10^6 \times 10{,}400 = 10.4 \times 10^4$ MMBtu/yr. Value at \$2.00/MMBtu = \$208,000.

2. Oil usage is ~5% of total.

3. DEIS II Utilities Report shows:

July 77	29 MMBtu	FSX
Aug. 77	No	FSX
Aug. 77	98×10^3 MMBtu	NAG
July 77	106×10^3 MMBtu	NAG

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Table 4

GREAT LAKES NAVY BOILERS/RDF
USE POTENTIAL

Load (percent)				Plant Energy Use (MMBtu)				
Mar	Jun	Sep	Year Constructed	Total Annual	Dec	Mar	Jun	Sep
26	14	23						
26	14	23						
26	14	23		Gas 2.6×10^6	962×10^3	676×10^3	364×10^3	598×10^3
26	14	23		Oil 4.48×10^3	1.66×10^3	1.16×10^3	0.62×10^3	1.03×10^3
26	14	23						
26	14	23						
33	0	16		Oil* 52.5×10^3	26.8×10^3	17.3×10^3	0	8.4×10^3
26	14	23		Oil* 52.5×10^3	19.4×10^3	13.7×10^3	7.6×10^3	12×10^3
11	45	30		Gas 35×10^3	4.9×10^3	3.9×10^3	15.8×10^3	10.5×10^3
11	45	30		Oil 12.3×10^3	1.7×10^3	1.4×10^3	5.5×10^3	3.7×10^3
32	0	22		Gas 7.2×10^3	3.3×10^3	1.9×10^3	0	1.6×10^3
27	14	21						
27	14	21		Gas 12.3×10^3	4.7×10^3	3.3×10^3	1.7×10^3	2.6×10^3
Total gas				2.65×10^6	975×10^3	685×10^3	382×10^3	613×10^3
Total oil				121×10^3	49.6×10^3	33.6×10^3	13.7×10^3	25.1×10^3
Overall				2.77×10^6	1025×10^3	719×10^3	396×10^3	638×10^3

*Fuel oil annual requirement closely matches solid waste energy available. Suggests possible matching with pyroil.

†Letter of 18 Aug 1977, Winters (NESO) to CNM 04FH, indicates 870,000 gallons resid. oil burned annually.

Page	Activity	Location	Size (MMBtu/hr)	Operating Time Hours/ Day	Days/ Week	Weeks/ Year	Fuel	Throughput (MMcf/kgal) Annual	Max. Hourly
1724	NAS Memphis	S-75-1 B & W	56.0	24	7	28	N.G./R.O.	109/75	0.053/0.37
1725	NAS Memphis	S-75-2 B & W	56.0	24	7	28	N.G./R.O.	109/75	0.053/0.37
1726	NAS Memphis	S-75-3 B & W	56.0	24	7	28	N.G./R.O.	109/75	0.053/0.37
1727	NAS Memphis	S-75-4 B & W	56.0	24	7	28	N.G./R.O.	109/75	0.053/0.37
1728	NAS Memphis	S-75-5 Wicks	113.0	24	7	22	N.G./R.O.	235/525	0.108/0.907
1729	NAS Memphis	N-15-1 Kewanee	12.0	24	7	21	N.G./Dist.	24/48	0.01/0.08
1730	NAS Memphis	N-15-2 Kewanee	12.0	24	7	21	N.G./Dist.	24/48	0.01/0.08
1731	NAS Memphis	N-15-3 Kewanee	12.0	24	7	21	N.G./Dist.	24/48	0.01/0.08
1732	NAS Memphis	N-15-4 Kewanee	12.0	24	7	21	N.G./Dist.	24/48	0.01/0.08
1733	NAS Memphis	N-15-5 Kewanee	12.0	24	7	21	N.G./Dist.	24/48	0.01/0.08
1734	NAS Memphis	N-15-6 Kewanee	12.0	24	7	21	N.G./Dist.	24/48	0.01/0.08
1735	NAS Memphis	S-237-1 Kewanee	12.0	--	--	--	N.G./Dist.	--	--
1736	NAS Memphis	S-237-2 Kewanee	12.0	--	--	--	N.G./Dist.	--	--
1737	NAS Memphis	S-88-1 Kewanee	12.0	24	7	28	N.G./Dist.	10/17	
1738	NAS Memphis	S-88-2 Kewanee	12.0	24	7	28	N.G./Dist.	10/17	

Table 5

NAS MEMPHIS BOILERS/RDF
USE POTENTIAL

Throughput (MMcf/kgal)		Load (percent)					Plant Energy Use (MMBtu x 10^3)				
nual	Max. Hourly	Dec	Mar	Jun	Sep	Year Constructed	Total Annual	Dec	Mar	Jun	Sep
9/75	0.053/0.37	23	27	23	27						
9/75	0.053/0.37	23	27	23	27		Gas 449	103	121	103	121
9/75	0.053/0.37	23	27	23	27		Oil 42	9.7	11.3	9.7	11.3
9/75	0.053/0.37	23	27	23	27						
5/525	0.108/0.907	60	20	0	20		Gas 242	145	48	0	48
							Oil 73.5	44	14.7	0	14.7
/48	0.01/0.08	38	26	10	26						
/48	0.01/0.08	38	26	10	26						
/48	0.01/0.08	38	26	10	26		Gas 148	56.2	38.4	5.6	38.4
/48	0.01/0.08	38	26	10	26		Oil 40.3	15.3	10.5	4.0	10.5
/48	0.01/0.08	38	26	10	26						
/48	0.01/0.08	38	26	10	26						
	--	--	--	--	--						
	--	--	--	--	--						
/17		26	25	24	25		Gas 20.6	5.4	5.2	4.9	5.2
/17		26	25	24	25		Oil 4.8	1.2	1.2	1.2	1.2

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Page	Activity	Location	Size (MMBtu/hr)	Operating Time: Hours/ Day	Operating Time: Days/ Week	Operating Time: Weeks/ Year	Fuel	Throughput (MMcf/kgal): Annual	Throughput (MMcf/kgal): Max. Hourly	D
1739	NAS Memphis	E-11-1 Kewanee	12.0	24	7	7	N.G./Dist.	8/21		
1740	NAS Memphis	E-11-3 Kewanee	12.0	24	7	7	N.G./Dist	8/21		
1741	NAS Memphis	E-11-4 Kewanee	12.0	24	7	7	N.G./Dist.	8/21		
1742	NAS Memphis	E-11-5 Kewanee	12.0	24	7	7	N.G./Dist.	8/21		
1743	NAS Memphis	100-1 Kewanee	12.0	24	7	26	N.G./Dist.	19/15		
1744	NAS Memphis	100-2 Kewanee	12.0	24	7	26	N.G./Dist.	19/15		
1745	NAS Memphis	100-3 Kewanee	12.0	24	7	26	N.G./Dist	19/15		
1746	NAS Memphis	S-89 Cleaver Brooks	3.0	24	7	52	N.G./Dist.	216/6.0		
1747	NAS Memphis	4-91-1 Kewanee	2.0	24	7	28	Dist.	7.2		
1748	NAS Memphis	BOQ Cleaver Brooks	3.0	24	7	28	N.G./Dist.	3.9/1.5		
1749	NAS Memphis	E-11-2 Kewanee	12.0	24	7	7	N.G./Dist.	8/21		
1750	NAS Memphis	1-1 Fitzgibbons	1.0	7	6	12	N.G.	1.4		

Note: Solid waste estimate

$40\ \text{tpd}_5 = 10{,}400\ \text{tpy} = 10.4 \times 10^4$ MMBtu/yr

Value at \$2.00/MMBtu = \$208,000.

Table 5 (Concluded)

Throughput (MMcf/kgal)		Load (percent)				Year	Plant Energy Use (MMBtu x 10^3)				
l	Max. Hourly	Dec	Mar	Jun	Sep	Constructed	Total Annual	Dec	Mar	Jun	Sep
		46	27	0	27						
		46	27	0	27		Gas				
							32.9	15.1	8.9	0	8.9
		46	27	0	27		Oil				
							11.8	5.4	3.2	0	32
		46	27	0	27						
		25	25	25	25		Gas				
							58.7	14.7	14.7	14.7	14.7
		25	25	25	25		Oil				
							6.3	1.6	1.6	1.6	1.6
		25	25	25	25						
.0		25	25	25	25	1975	Gas				
							2.7	0.7	0.7	0.7	0.7
							Oil				
							0.8	0.2	0.2	0.2	0.2
		50	10	0	40	1973	Dist. oil				
							1.0	0.5	0.1	0	0.4
.5		50	10	0	40	1975	Gas				
							4.0	2.0	0.5	0	1.6
							Oil				
							0.2	0.1	0.01	0	0.08
		46	27	0	27		Gas				
							8.2	3.8	2.2	0	2.2
							Oil				
							2.9	1.3	0.8	0	0.8
		50	25	0	25	1948	Gas				
							1.4	0.7	0.4	0	0.4
		Total (gas)					968	347	240	129	
		Total (oil)					183	79	44	17	
		Overall					1151	426	284	146	

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ge	Activity	Location	Size (MMBtu/hr)	Operating Time: Hours/ Day	Days/ Week	Weeks/ Year	Fuel	Throughput (MMcf/kgal): Annual	Max. Hourly	Load (percent): Dec	Mar	Jun	Sep	Con
06	NAS JAX	104-1 Keeler	45.0	24	7	40	N.G./Res. Oil	436/1.0	0.045/	34	15	20	31	
07	NAS JAX	104-2 Keeler	45.0	24	7	40	N.G./Res. Oil	436/1.0	0.045/	34	15	20	31	
08	NAS JAX	104-3 Keeler	45.0	24	7	40	N.G./Res. Oil	436/1.0	0.045/	34	15	20	31	
09	NAS JAX	104-4 Keeler	45.0	24	7	40	N.G./Res. Oil	436/1.0	0.045/	34	15	20	31	
10	NAS JAX	650-7 B & W	45.0	24	7	40	N.G./Res. Oil	301/1.0	0.045/	34	37	15	14	
11	NAS JAX	650-8 B & W	45.0	24	7	40	N.G./Res. Oil	301/1.0	0.045/	34	37	15	14	
12	NAS JAX	650-9 B & W	45.0	24	7	40	N.G./Res. Oil	301/1.0	0.045/	34	37	15	14	
13	NAS JAX	650-10 B & W	45.0	24	7	40	N.G./Res. Oil	301/1.0	0.045/	34	37	15	14	
14	NAS JAX	H2032-26	12.0	24	7	40	N.G./Diesel	33/1.0	0.012/	21	24	30	25	
15	NAS JAX	H2032-27	12.0	24	7	40	N.G./Diesel	33/1.0	0.012/	21	24	30	25	
16	NAS JAX	H2032-28	25.0	24	7	40	N.G./Diesel	67/2.0	0.025/	21	24	30	25	
17	NAS JAX	H2032-29	25.0	24	7	40	N.G./Diesel	67/2.0	0.025/	21	24	30	25	
18	NAS JAX	Test Cell 1 Cleaver Brooks	2.0				Dist. Oil							
19		BEQ-1 Cleaver Brooks	4.0				Dist. Oil							
20		13-1 Kewanee	2.0	10	7	24	Dist. Oil	/0.90		50	0	0	50	
21	NAS JAX	13-2 Kewanee	2.0	10	7	24	Dist. Oil	/0.90		0	50	50	0	
												Total gas		
												Total oil		
												Overall		

tes: 1. Assume JAX solid waste to be 40 tpd_5 and 1 ton contains 10×10^6 Btu, then annual heat content is $40 \times 260 \times 10$
At \$2.00/MMBtu, this has a heat value of \$208,000/yr.

2. Solid waste energy available is 0.104/3.2 = 3.25% of heat load on average; during least quarter (June-Aug) it i

$$\frac{0.104}{0.6 \times 4} \text{ or } \frac{0.104}{2.4} = 4.3\% \text{ of heat load.}$$

				Operating Time				Throughput (MMcf/kgal)		Load (percent)		
Page	Activity	Location	Size (MMBtu/hr)	Hours/ Day	Days/ Week	Weeks/ Year	Fuel	Annual	Max. Hourly	Dec	Mar	Ju
806	NAS JAX	104-1 Keeler	45.0	24	7	40	N.G./Res. Oil	436/1.0	0.045/	34	15	20
807	NAS JAX	104-2 Keeler	45.0	24	7	40	N.G./Res. Oil	436/1.0	0.045/	34	15	20
808	NAS JAX	104-3 Keeler	45.0	24	7	40	N.G./Res. Oil	436/1.0	0.045/	34	15	20
809	NAS JAX	104-4 Keeler	45.0	24	7	40	N.G./Res. Oil	436/1.0	0.045/	34	15	20
810	NAS JAX	650-7 B & W	45.0	24	7	40	N.G./Res. Oil	301/1.0	0.045/	34	37	15
811	NAS JAX	650-8 B & W	45.0	24	7	40	N.G./Res. Oil	301/1.0	0.045/	34	37	15
812	NAS JAX	650-9 B & W	45.0	24	7	40	N.G./Res. Oil	301/1.0	0.045/	34	37	15
813	NAS JAX	650-10 B & W	45.0	24	7	40	N.G./Res. Oil	301/1.0	0.045/	34	37	15
814	NAS JAX	H2032-26	12.0	24	7	40	N.G./Diesel	33/1.0	0.012/	21	24	30
815	NAS JAX	H2032-27	12.0	24	7	40	N.G./Diesel	33/1.0	0.012/	21	24	30
816	NAS JAX	H2032-28	25.0	24	7	40	N.G./Diesel	67/2.0	0.025/	21	24	30
817	NAS JAX	H2032-29	25.0	24	7	40	N.G./Diesel	67/2.0	0.025/	21	24	30
818	NAS JAX	Test Cell 1 Cleaver Brooks	2.0				Dist. Oil					
819		BEQ-1 Cleaver Brooks	4.0				Dist. Oil					
820		13-1 Kewanee	2.0	10	7	24	Dist. Oil	/0.90		50	0	0
821	NAS JAX	13-2 Kewanee	2.0	10	7	24	Dist. Oil	/0.90		0	50	50

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Notes: 1. Assume JAX solid waste to be 40 tpd and 1 ton contains 10×10^6 Btu, then annual heat content is 40
At \$2.00/MMBtu, this has a heat value of \$208,000/yr.

2. Solid waste energy available is 0.104/3.2 = 3.25% of heat load on average; during least quarter (Jun

$\frac{0.104}{0.6 \times 4}$ or $\frac{0.104}{2.4}$ = 4.3% of heat load.

Table 6

JACKSONVILLE BOILERS/RDF
USE POTENTIAL

Load (percent) Dec	Mar	Jun	Sep	Year Constructed	Plant Energy Use (MMBtu) Total Annual	Dec	Mar	Jun	Sep
34	15	20	31						
34	15	20	31		Gas 1.8×10^6	612×10^3	270×10^3	360×10^3	558×10^3
34	15	20	31		Oil 560	190	80	110	170
34	15	20	31						
34	37	15	14						
34	37	15	14		Gas 1.2×10^6	408×10^3	444×10^3	180×10^3	168×10^3
34	37	15	14		Oil 560	190	210	80	80
34	37	15	14						
21	24	30	25						
21	24	30	25		Gas 0.2×10^6	42×10^3	48×10^3	60×10^3	50×10^3
21	24	30	25		Oil 300	60	70	90	80
21	24	30	25						
				1975					
				1975					
50	0	0	50		Oil 250	125	125	125	125
0	50	50	0						
	Total gas				3.2×10^6	1.06×10^6	0.762×10^6	0.600×10^6	0.776×10^6
	Total oil				1.67×10^3	0.565×10^3	0.485×10^3	0.405×10^3	0.455×10^3
	Overall				3.2×10^6	1.07×10^6	0.76×10^6	0.6×10^6	0.78×10^6

t content is $40 \times 260 \times 10^7 = 10400 \times 10^7$ or 0.104×10^6 MMBtu.

t quarter (June-Aug) it is

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